

ROBOT MODELING OF THE CATAGLYPHIS BICOLOR

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Insect navigation provides robot modeling opportunities for investigating both the insect and robot guidance systems. This work consists of a two-stage robot project based upon the behavior of the Cataglyphis Bicolor ant.

The Cataglyphis Bicolor is a species of desert ant that navigates without the use of pheromones. This type of ant has been the subject of many studies because it uses the sun and other environmental cues as its guides. The ant is believed to use landmarks such as trees, rocks, or brush to also improve its accuracy.

The vehicle used in this study was an MIT-designed Handy Board-driven Lego robot. Light sensors and servomotors provided the input for much of the information processing in the robot. Interactive C was used on the Handy Board to design and implement the robot control software.

The first stage of the modeling project focused on the ant's ability to find its nest by using remembered "snapshots" of surrounding landmarks near its nest. The ant is believed to match its current view of the landmarks with the snapshot that it saw at the nest while attempting to find its way home. Because researchers have not determined the exact method or algorithm that the ant uses to match the snapshot and current view, the modeling project simulated alternative approximations of ant behavior.

The first stage of the project was designed to test landmark navigation algorithms and get to know the hardware and software to improve subsequent projects. Three simple algorithms were developed and tested in this stage of the research; none of them were exactly what the ant uses. Much was learned about how movement and depth is perceived to the ant. This stage also provided a great platform to test future algorithms and theories for the landmark navigation.

The second stage of the modeling project concentrated on the centering response of the Cataglyphis Bicolor. The desert ant avoids landmarks while randomly foraging because many of its predators hide in the landmarks. When two landmarks are present, the ant centers itself between the landmarks so the angle from the top of each landmark to the ground is equal for both landmarks.

A new robot was constructed and programmed to imitate the centering response of the Cataglyphis Bicolor. Rope lights were used to simulate the top of the landmarks, and the robot was equipped with actuated light sensors to "find" the top of each landmark. This robot also incorporated many other realistic characteristics like wandering, foraging for food, and keeping track of the distance traveled. Multiple processes were used to coordinate all the sensors, movements, and reactions for the robot, emulating the many processes that the actual ant has to manage. The software for this stage was also designed to allow for future experiments with other ant behavior.

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